1. Franseria Chamissonis subsp. **typica** nom. nov. *Franseria Chamissonis* Less. Linnaea 6: 507. 1831. *Franseria Chamissonis* var. *malvaefolia* Less. Linnaea 6: 507. 1831. *Franseria cuneifolia* Nutt. Trans. Am. Phil. Soc. ser. 2, 7: 345. 1840. *Franseria Chamissonis* var. *cuneifolia* Torr. & Gray, Fl. N. Am. 2: 293. 1842. *Gaertneria Chamissonis* Kuntze, Rev. Gen. 339. 1891. *Ambrosia Chamissonis* Greene, Man. Bay Reg. Bot. 188. 1894.

Leaves serrate to the cuneate base; bur channeled above.

Sandy coastal regions, San Clemente and San Miguel Islands, and from middle California to Washington.

2. Franseria Chamissonis subsp. **bipinnatisecta** comb. nov. *Franseria Chamissonis* var. *bipinnatisecta* Less. Linnaea 6: 507. 1831. *Franseria bipinnatifida* Nutt. Trans. Am. Phil. Soc. II. 7: 344. 1840. *Franseria Lessingii* Meyen & Walp.; Walp. Nova Acta Acad. Leop. Carol. 19: Suppl. 268. 1843. *Gaertneria bipinnatifida* Kuntze, Rev. Gen. 339. 1891. *Ambrosia bipinnatifida* Greene, Man. Bay Reg. Bot. 187. 1894. *Franseria bipinnatifida dubia* Eastw. Proc. Calif. Acad. ser. 3, 1: 117. 1898. *Gaertneria bipinnatifida dubia* A. Heller, Muhl. 1: 6. 1900. *Franseria bipinnatifida villosa* Eastw.; Rydb. N. Am. Fl. 33: 26. 1922, as synonym. *Franseria villosa* Rydb. N. Am. Fl. 33: 26. 1922.

Leaves once to thrice pinnatifid, bur ovoid but more slender than in *typica* with spines sub-terete and usually only slightly channeled above.

Range: British Columbia to Lower California. The South American form seems to be this subspecies or a variant thereof, and may be an introduction.

Stanford University, California.
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ON THE POLLEN OF THE MIMOSOIDEAE AND THE IDENTITY OF THE SUPPOSED ALGA PHYTOMORULA

Herbert F. Copeland

The state of California harbors a few native species of Mimosoideae, together with a large number of introduced species, including about three of *Albizzia* and more than three-score of *Acacia*. It may not be inappropriate to summarize what is known about the remarkable clusters of pollen grains produced by some of the members of the group. The existence of these clusters is no new discovery: it is noted in several of the standard reference works (1, 8, 10, 11); it has been reported for Californian material by Rowe (7); it has been known for more than a hundred years.

I have not been able to confirm a reference to the writings of Köhlreuter. The oldest paper which I have seen that describes these clusters is by von Mohl (4), who distinguished a variety of types of clusters almost exactly as they are known up to the present.

Rosanoff (6) added examples to the types already distinguished by von Mohl, and studied the development; his account of the process in the majority of the species may be transcribed into modern terms as follows. In each microsporanguim, all of the archesporial cells except two become sterile. The two fertile cells divide once, twice, or three times, forming clusters of two, four, or eight microspore mother cells. Each of the latter forms a tetrad of microspores. The outcome is the production, by each anther, of eight clusters of pollen grains, each cluster consisting of eight, sixteen, or thirty-two grains. (It is evident that by homology each unit of the cluster is a pollen grain. We should not regard the whole cluster as a single grain, though some authors have done so.) As an anomalous exception, Rosanoff found in a few species clusters of twelve pollen grains; these, it is evident, represent clusters of three pollen mother cells derived from single fertile archesporial cells.

Wodehouse (11) brought to the description of these clusters an extensive knowledge of the systems of grooves on the surfaces of pollen grains. He interprets the quadrate markings found on the exposed surfaces of the grains of *Acacia* as representing his dodecacolpate (12-grooved) system. In the species commonly known as *Acacia Farnesiana,* he finds the grains hexacolpate (6-grooved); this seems sufficient justification for his excluding it from *Acacia,* under the old name *Vachellia Farnesiana* Wight & Arnold.

What remains to be accomplished is a correlation of the characters of the clusters and grains with the classification of the group. Rosanoff remarked of the variety of types of clusters that it "dient noch einmal als Bestätigung des alten Satzes von Köhlreuter, dass die Aehnlichkeit der Pollenkörner nicht immer mit dem Umgrenzung der Verwandtschaftskreise zusammenfällt." This in effect gave the taxonomists license to pay no attention to the pollen grains; and they seem to have taken advantage of it. But Rosanoff wrote at a time when the limits of the most familiar genera, *Mimosa, Acacia,* and *Albizzia,* were not understood; and I have encountered a number of facts which suggest that when all of the genera are well understood the type of pollen will be found uniform in each. Thus as noted above, when Wodehouse found the Farnesian species to differ from *Acacia* in a character of the pollen, he found also that it had long before been excluded from *Acacia* on the basis of other characters. Again, Merrill removed the rain tree (a common ornamental in the tropics) from *Pithecolobium,* and placed it in another genus as *Samanea Saman;* its pollen grains are in clusters of thirty-two, instead of sixteen as in the only species of *Pithecolobium* I have examined. Most species of *Inga* seem uniform in type of cluster; but von Mohl, dealing with *I. anomala,* and

Rosanoff, dealing with *I. tergemina,* found in these species a quite distinct type. I have myself found this type in *Calliandra grandiflora;* and I cannot but suspect that the peculiar species of *Inga* might better be placed in *Calliandra.* But the re-shuffling of the group cannot be attempted at this time. More than thirty genera are recognized in the Mimosoideae; we know by observation in California how numerous in species *Acacia* is; and a glance at the literature shows that *Inga, Pithecolobium, Enterolobium,* and *Calliandra* are comparably numerous.

The following outline of the pollen types is based primarily on my own observations; the examples which I have seen are marked with exclamation points. All the observations were made on herbarium material. The pollen is most easily seen by dissecting out and crushing the anthers of buds which are just in the act of opening. From among the many examples offered by the older authors I have cited but few, because I do not trust the generic names they used.

I. THE GRAINS OR CLUSTERS NUMEROUS IN EACH ANTHER

Grains solitary: *Leucaena glauca! Desmanthus* spp. and *Entada* spp., *fide* von Mohl, Rosanoff, and Wodehouse; all species of *Prosopis, fide* Wodehouse; some species of *Mimosa, fide* Rosanoff.

Grains in tetrads: *Mimosa pudica* and other species, also *Schrankia unciniata, fide* Rosanoff.

Grains in octets: *Schrankia* sp., *fide* Rosanoff.

II. THE GRAINS IN CLUSTERS; CLUSTERS EIGHT IN EACH ANTHER

The tetrads tetrahedral, so that the grains lie in more than one plane.

1. The grains interpretable as dodecacolpate, each having a quadrate marking (sometimes seen as circular) on the exposed surface.
   - a. Grains in octets: *Acacia armata! A. tenuifolia* (Pl. XX, fig. 1)! and various other species, *fide* von Mohl and Rosanoff.
   - b. Grains in clusters of twelve: *Acacia rutaefolia, A. pentadenia,* and *A. pulchella, fide* Rosanoff.
   - c. Grains in clusters of sixteen, the greatest dimension of the cluster 30–50 microns. Throughout the family, clusters of sixteen or more grains are always of a lenticular form, half of the grains forming a circumferential belt, while the rest are in two clusters, one on each of the broad surfaces. The limits of the tetrads are obvious, each consisting of two adjacent circumferential cells and one cell from each of the superficial groups. *Acacia Baileyana* (Pl. XX, fig. 2)! *A. cultriformis! A. decurrens* var. *dealbata! A. elata! A. longifolia! A. melanoxylon! A. neriifolia! A.*

podalyriaefolia! A. retinoides! A. verticillata! and various other species, *fide* von Mohl and Rosanoff. The only species outside of *Acacia* which is known to me as probably belonging here is *Archidendron Vaillantii;* Taubert's figure (after von Mueller) appears to show the quadrate surface markings.

2. The grains hexacolpate, the exposed surfaces divided into three prominent protuberances; grains in clusters of sixteen: *Vachellia Farnesiana!*
3. The grooves essentially obsolete, so that the grains appear smooth.
   a. Grains in clusters of sixteen, of which the greatest dimension is 75–100 microns: *Albizzia Acle! A. Julibrissin* (Pl. XX, fig. 3) ! *A. Lebbek! A. lophantha! Inga myriantha, fide* Wodehouse; *Pithecolobium dulce!*
   b. Grains in clusters of thirty-two, greatest dimension 90–160 microns: *Inga cordistipula, fide* Taubert after Bentham (actually seven tetrads, not eight, are shown) ; *I. edulis! I. spectabilis, fide* Rosanoff (as an individual variation, some clusters of thirty-six grains) ; *Samanea Saman!* (Pl. XX, fig. 4).

Cells of the tetrad lying in one plane; tetrads always two, so that the cluster is a flat plate of eight. The clusters are exceedingly large, to 250 microns long; the two ends are not alike, so that the outline in surface view is lanceolate. Von Mohl reported a cluster of minute cells, serving as a clinging organ, at the pointed end. Rosanoff could see nothing but the naked point. My own understanding of the situation is as follows. The pointed end is, in the anther, pressed against a large sterile cell. Under some circumstances it may break completely free; under others, it may be found attached to a scrap of cell wall. *Inga anomala, fide* von Mohl; *I. tergemina, fide* Rosanoff; *Calliandra grandiflora!* (Pl. XX, fig. 5).

On the basis of these data, one may point out a few mistakes, of observation or of interpretation, which have been published.

Rowe's figure of pollen of *Acacia* is readily recognizable but is not strictly accurate. It duly shows the quadrate protuberances on the four cells occupying one surface of the cluster. But as to the belt of circumferential cells, it shows protuberances, not on the edges, but on the surfaces toward the observer. Von Mueller's figure for *Archidendron Vaillantii* shows the same feature, and is presumably in error in the same way.

Pope (5), referring to *Acacia mollissima* (the name is a synonym of *A. decurrens*), describes "Grains . . . almost spherical; surface reticulated, reticulations forming large 4-sided facets." It is evident that she has mistaken the cluster of sixteen grains for a single grain.

Some twenty years ago, Kofoid (2) described and illustrated certain sixteen-chambered structures found by him in a reservoir in Berkeley during the month of March (when, according to Rowe, *Acacia* pollen is most abundant). He looked about, naturally, for something with a family resemblance to these structures, and there was nobody to call to his attention the Mimosoideae; he recognized *Coelastrum* as something similar, and described his material as a new alga, *Phytomorula regularis*. More recently, Smith (9) has reported and illustrated an additional collection of *Phytomorula* (at Stanford University, according to a personal communication from Dr. Smith). The two accounts refer to things slightly different in size and shape, but within the range of the size and shape of clusters of *Acacia* pollen, and consisting of units arranged as in *Acacia* pollen. Kofoid's illustration shows on each cell a minute dome-shaped protuberance; Smith's shows a large one; the protuberances as shown do not agree well with each other, nor with the large quadrate protuberances on the pollen grains of *Acacia*. I have not been able to explain these discrepancies; possibly they depend on conditions of exposure. I am confident, however, that *Phytomorula* as published respectively by Kofoid and Smith is the pollen of two different species of *Acacia*.

Sacramento Junior College,
Sacramento, California, March, 1937.

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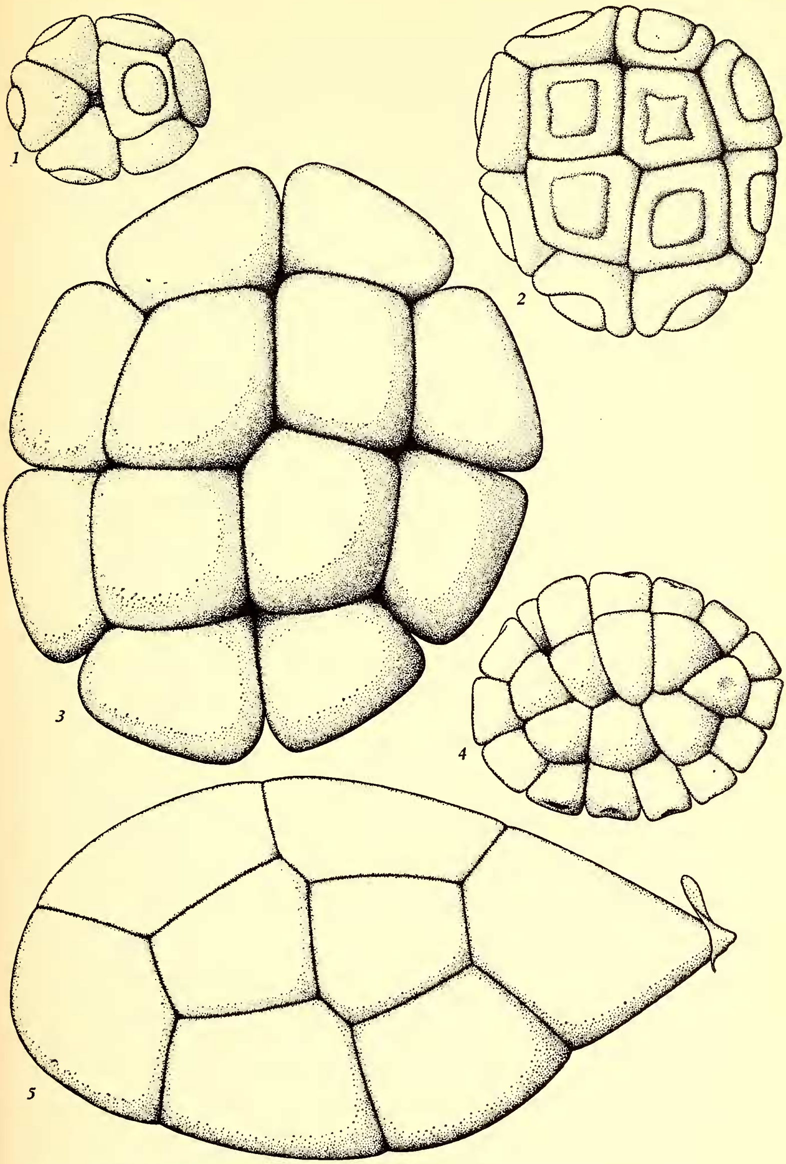

Plate XX. Clusters of pollen grains of certain Mimosoideae. Fig. 1. *Acacia tenuifolia* × 800. Fig. 2. *Acacia Baileyana* × 800. Fig. 3. *Albizzia Julibrissin* × 800. Fig. 4. *Samanea Saman* × 400. Fig. 5. *Calliandra grandiflora* × 400.